Playful Sounds From The Classroom: What Can Designers of Digital Music Games Learn From Formal Educators?

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Abstract
In this paper, formal music education is seen as a starting point to understand how digital music games can further innovate to heighten their educational potential. In the paper, seven opportunities for innovation of digital music games are presented. These are the result of observations of music lessons, and interviews and stimulated recall sessions with music educators. During the data analysis, the researchers looked at the strategies used by the educators and compared these to an overview of digital music games they had made, in order to formulate the suggestions for innovation for digital music games.

Author Keywords
Music education; digital music games; Design inspiration; Observation; Stimulated recall; Interviews.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Digital music games are increasingly analyzed in their ability to be educational tools, particularly for children [3,7]. Typically, five music elements are considered to be necessary to ensure a good understanding of music. These are: duration, pitch, tone color, dynamics, and structure [8]. Music education programs state that

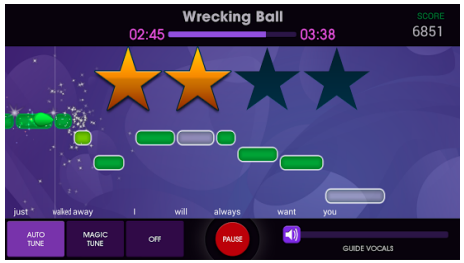

Figure 1 Screenshot of the StarMaker app

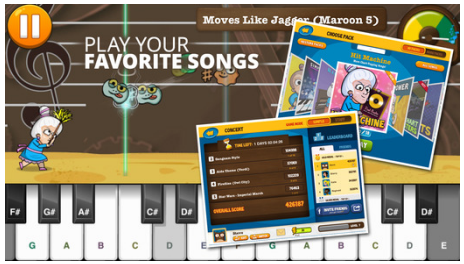

Figure 2 Screenshot of the Piano Dust Buster app

Figure 3 Screenshot of the Toca Band app

these elements not only need to be recognized or heard by children, but that children need to actively experience these by making music themselves in a variety of ways in order to have a complete understanding of music [8]. Digital music games can be such active learning environments, especially since they have the potential to instill intrinsic motivation with their users and allow for deep engagement while playing [2,7].

Today, formal music education is at times shortcoming in teaching music: there seems to be a gap between the way music is formally being taught and how children experience music in their daily lives. For instance, in Flanders (Belgium), the first year of study in formal music education for children is cognition-driven, with little to no room for practical music experience. The focus is on music theory: students are not yet allowed to pick up an instrument [1]. Moreover, there seems to be a gap between the styles of music that are used in formal education and the styles of music most children preferably listen to. Especially during the first years of music education, teachers use classical music. Mainstream music is rarely included. As such, students learn about music they have little connection with in daily life. This can be a bewildering and discouraging experience, which is understood to cause drop out [5], as it is important to connect a learning experience to students' own practices [4].

While the shortcomings of formal music education have been widely researched and discussed (e.g. [1]), it would of course be wrong to discard the practices in formal education altogether. The purpose of the research described in this paper was to have a closer look at formal music education, and see how digital music games could draw inspiration from these practices to further innovate an heighten their educational potential.

Background

It seems that educational music apps can roughly be divided into three main categories. The first category consists of apps focusing on the skills required to make music, such as singing or playing an instrument (e.g. StarMaker [9]) (Fig. 1). These apps mostly make a live audio analysis of the user's voice or the sound of the instrument played, and match this to the original music score via for instance an XML file. The second category contains music games, such as Piano Dust Buster 2 [10] (Fig. 2), that are based on repeating a melody in a game-like environment, without making use of an external audio source. Apps in the third category, finally, stimulate users to be creative with music. Such apps, like Toca Band [11] (Fig. 3) usually offer an exploratory environment or tools that allows users to create music.

The research described in this paper is part of the MELoDiA project, which aims to develop a music app of the first category. More specifically, the goal is to provide children with a playful first encounter with music education, by helping them to learn how to sing. The goal of this project was to combine educational and game principles to create an application that teaches children to make music while having fun. Musical content from popular TV shows is used to increase motivation for learning. The application makes a real-time analysis of the children musical performance, and players receive feedback both during and after singing. The delayed feedback consists of an overview highlighting the sections where there is room for

improvement. Players are then offered mini games that encourage practicing these sections. The application is not intended to replace formal music education. Rather, it aims to complement it by giving children a compelling first experience with acquiring musical skills.

In order to understand how grounded principles of music education could be employed in the music application, one of the first research steps was to study current practices in formal music education. More specifically, we were interested in how teachers interact with their students during music lessons: How do they give feedback? Which teaching strategies do they use? Our aim was to analyze current practices and to understand how these may be translated into new opportunities for creating a digital music game that is both fun to play; as well as educationally sound. While we of course wished to avoid the pitfalls of formal music education, we also wanted to retain those elements that could inform the design of music applications and heighten their educational value.

In this paper, we concentrate on those strategies that seem to have most potential for innovation and can push developers to include functionalities that go beyond the current state-of-the-art in terms of educational digital music games. The main contribution of this paper is providing researchers and designers, working on digital music games, with inspiration from music education.

Methods

To study current practices in music education, we embarked on three research endeavors, namely observations, stimulated recalls and interviews.

Music lesson observations

Two music teachers were asked to prepare and teach music lessons both at a primary school and at two dedicated music schools. Specifically, they were asked to teach the children (aged 8 to 10 years old) to sing a specific song from a popular children's TV show (cf. the MELoDiA concept). The teachers were asked to give a lesson as they would normally do, employing their preferred teaching strategies and techniques. One teacher gave four lessons (two at a primary school and two at a music school), the other gave one lesson (at a music school). Each lesson was observed by a project researcher. All five lessons were video recorded.

Stimulated recalls

The teacher who taught four lessons further participated in two stimulated recall sessions. Stimulated recall is an interviewing technique that provides insight into subjects' cognitive processes by inviting them to recall their thinking during an event, while prompted by a video sequence [6]. As such, the purpose of these sessions was to understand the teacher's considerations on her actions during the lessons. In both sessions, one of the researchers showed the recording of the teacher's own lesson and the teacher was asked to comment on the video. The researcher made notes of the teacher's comments, and later integrated in detailed stimulated recall reports.

Interviews with music teachers

Six teachers participated in semi-structured interviews. Three teachers were primary school teachers (who also teach music), while the other three teachers taught music lessons at dedicated music schools. The interviews consisted of three parts. The first part was a

1. Create an encouraging **atmosphere**
2. Enable **autonomy**
3. **Challenge** students
4. Use **content** that is both educational and engaging
5. Provide constructive **feedback** & immediate **correction**
6. Foster **creativity** and use imagination
7. Stimulate interpretation and **expression**
8. Use **imitation** as a learning technique
9. Adapt to **individual** students' needs
10. Stimulate proper use of **body** and **voice**
11. Create **exercises** to practice specific musical skills
12. **Explain technical issues** in an easy-to-understand way
13. **Motivate** students by means of a good set-up for each lesson
14. Encourage students to give **performances**
15. Use voice **warming-up** exercises
16. Teach songs in **small steps**, start with the easy parts
17. Use **social** dynamics to motivate students
18. Promote active **listening**

Table 1 The main topics that emerged from the analysis of common practices in formal music education.

semi-structured interview in which the teachers were asked about their education and current professional activities, their approach in music lessons and how they motivate their students. In the second part, the teachers were shown a compilation of the videos that were made of the observed lessons. These videos were used as a prompt to discuss their views on the best approach to teach children to sing a song. In the final part, the researcher conducting the interview presented the MELoDiA concept to the teacher by means of a storyboard showing the main functionalities of the future MELoDiA app. The teacher was invited to reflect and give feedback on both the individual features of the app and the concept in general. Each interview was audio recorded and the researchers detailed interview reports based on these recordings.

Analysis

The final data set consisted of three observation reports, two stimulated recall reports and six interview reports. These data were analyzed according to an iterative coding procedure. The focus lay on the identification of strategies teachers used during class, since the aim was to gain inspiration from these for new digital music applications. We first did a sequential open coding of the data. Four researchers divided the data amongst themselves for coding and coded their part of the data sequentially. The next step was an axial coding, which resulted in a new coding structure. The original data were recoded according to this new structure, resulting in a total of 18 main topics or 'strategies' employed by the music educators.

These 18 strategies were then discussed in relation with an overview of commercially available digital music games the researchers had conducted at the start of the MELoDiA project. The four researchers involved discussed each of the 18 strategies and how researchers, designers and developers aiming to go beyond the current state-of-the-art of digital music games could be inspired by these strategies. In the results section below, we discuss in detail the topics that we consider to be most promising to inspire innovative digital music games.

Results

Table 1 provides an overview of the 18 main strategies that resulted from the analysis of current practices in teaching children to sing a song in formal music education. Below, we elaborate on the strategies and practices that, in our opinion, hold most promise for original and innovative new directions in educational digital music games. Some of these strategies have of course been addressed in general educational theory too, but we will detail how they pose specific problems for digital music games.

Choice of content

While many digital music games today are based on popular music that appeals to children, the challenge remains to find content that is not only appealing but at the same time suitable for teaching children new skills and knowledge at their level. The choice of content is highly important for children's motivation in music education. Teachers constantly search for a balance between songs that appeal to their students on the one hand, and songs that are pedagogically interesting on the other hand. Many games provide children with a high level of autonomy, letting them choose the content they want to work with (and often the content is also an important part of the business model of many games). There is to be a high potential for innovation to

combine this autonomy in content choice with high educational value.

Focus feedback & correction on important errors
Teachers find it important to correct children immediately when they make errors. Otherwise, children may acquire wrong skills or techniques, which are difficult to unlearn. But not all errors are equally important. Teachers usually only correct those errors that are highly relevant, to avoid discouraging the children in the learning process. Current technology allows for audio analysis and error detection in digital music games. However, an important challenge remains to detect those errors are important to correct from an educational point of view, and which are redundant and can be ignored.

Foster creativity
Several digital music games allow children to explore and experiment with sounds and instruments. However, a challenge that remains and may be an interesting functionality to offer in future digital music games, would be to support children in this process of exploration and creativity. How can the application give intelligent feedback on children's creative expressions? How can it help children to not only use music in a creative way, but also encourage them to try new things and give a more qualitative, educational feedback on that improvisation?

Stimulate proper use of voice and expression
Teachers spend much time and effort on teaching vocal and breathing techniques. For instance, children have to learn how to sing loudly using the correct singing technique (and e.g. avoid shouting). Digital music games with educational purposes could coach children to this end. A straightforward way to do this would be to give instructions on using vocal techniques. However, it would be more effective to give feedback on the children's actual use of voice by means of audio analysis. Similarly, children can use their voices in several ways to express emotion and meaning. Children should learn to interpret the meaning of a song and to adjust their performance accordingly. While it is easy to tell children what a song is about and which emotion it should trigger, it is more difficult to translate expressions such as emotion or articulation to current possibilities in audio analysis (e.g. pitch and intensity).

Splitting up songs in smaller units
To facilitate learning, teachers commonly reduce parts of a song into smaller exercises, each focusing on one element of the song (e.g. text, pitch, or rhythm). It would be interesting to develop a digital music game that is able to (i.e. by means of an appropriate algorithm) turn any song into smaller, basic units as well, and to assign appropriate musical exercises to those elements (based on the music XML). This approach is similar to 'tutorial levels' in other game genres. However, we have not yet observed such functionalities in digital music games.

Variation: balance autonomy and structured exploration
Offering variation during a lesson is a common strategy to keep children focused by providing challenges that are sufficiently diverse. Teachers alternate several dedicated exercises and games, designed to practice specific musical aspects (e.g. rhythm clapping, 'repeat after me' singing, etc.), with singing (parts of) songs. Digital games allow for creating environments that offer a step-wise teaching approach with a high degree of variation (e.g. by offering many exercises in the form

of mini games). The challenge here is avoid a strict, linear game structure that takes away the learner's autonomy, but still finding a way to offer smaller challenges (e.g. in the form of a 'mini game') that are both educational and offer sufficient changes. This seems to create an interesting opportunity, namely to develop a game that stimulates exploration in such a way that children start looking for variation themselves.

Implement social dynamics

Teachers commonly make use of social dynamics during their lessons to keep their students focused and motivated. Examples include singing together and group competitions. Although many apps and games have some sort of social dimension, adding social elements to a game aimed at children is challenging in many ways. Creating a safe learning environment that incorporates age-appropriate social features for children may be an interesting research topic.

Conclusion

The goal of this research phase was to understand which common practices in formal music education could provide inspiration for innovative digital music games. The strategies and challenges we discussed are intended as starting points for the development of new music apps with an educational focus. Despite the shortcomings of this research, notably the limited number of participants, future research and development activities may continue to focus on these challenges; which may result in interesting new digital game directions for music education.

Acknowledgements

The research presented in the paper is part of the MELoDiA project. MELoDiA is a project co-funded by iMinds, a digital research institute founded by the Flemish Government. Project partners besides the iMinds research groups, are Cartamundi Digital and Mu Technologies (both with project support from IWT) and the Halewynstichting.

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